

Morphology and identification of a previously undescribed fossil catarrhine tooth from the middle Miocene of Romania. K.P. MCNULTY<sup>1,2,3</sup>, C. RADULESCO<sup>4</sup>, P. SAMSON<sup>4</sup>, M. FERU<sup>4</sup>, and E. DELSON<sup>1,2,3,5</sup>. <sup>1</sup>Dept. Anthropology, Lehman College; <sup>2</sup>City University of New York Graduate School; <sup>3</sup>New York Consortium in Evolutionary Primatology (NYCEP); <sup>4</sup>Institutul de Speologie "Emil Racovitza", Bucharest, Romania; <sup>5</sup>American Museum of Natural History.

Fieldwork in 1978 at the late middle Miocene (13-11 Ma) site of Taut, Romania recovered a number of mammalian fossils, including an isolated, non-cercopithecoid catarrhine tooth. The specimen is a moderately worn and slightly eroded left lower molariform tooth without roots. Some features of its morphology suggest that this tooth may be a deciduous premolar: long, narrow trigonid; relatively high buccal flare; low breadth-length index; accessory cresting in the mesial fovea; broad talonid relative to the trigonid; and buccal cusps placed anterior to lingual cusps. Comparisons with the molars and deciduous premolars of extant and fossil hominoids as well as pliopithecids (and other archaic catarrhines such as *Dendropithecus*) suggest that this specimen may be a hominoid dP<sub>4</sub>, due to its: broad talonid; elongate mesial fovea; long, gradual, lingually oblique postmetacristid; lingually projecting entoconid; deep lingual notch; and anteriorly placed buccal cusps.

On the other hand, the Taut specimen bears a general phenetic resemblance to lower molars of crouzeiine pliopithecids. Similarities include a low breadth-length index, elongate mesial fovea, narrow mesial breadth relative to distal breadth, buccolingual waisting, reduced hypoconulid, and a restricted distal fovea. There is no indication of a pliopithecine triangle. This tooth cannot be readily placed within any known pliopithecoid taxon.

Overall, morphological evidence best supports the hypothesis that this is a hominoid deciduous premolar. A linear regression of M<sub>1</sub> to dP<sub>4</sub> size in hominoids suggests that this specimen is smaller than one would expect for synchronic European *Dryopithecus*. Due to its isolated biogeographic position and its distinctive morphology, this tooth broadens our current understanding of the variation and distribution of Miocene catarrhines.

This research was supported by an NSF Research Training Groups Award to NYCEP.

The Fontéchevade Fossils: A reanalysis of their archaeological context based on new excavations. S.P. MCPHERSON, Bishop Museum, P.G. CHASE, University of Pennsylvania Museum, A. DEBÉNATH, University of Perpignan, H.L. DIBBLE, University of Pennsylvania, B.B. ELLWOOD, University of Texas Arlington.

The site of Fontéchevade, excavated during the middle part of this century, is well known for its two hominid cranial fragments and their associated stone tool industry. Both the fossils and the lithics have played important roles in the history of paleoanthropological research: the former providing strong evidence for the "pre-sapiens" model of Pleistocene hominid evolution, and the latter becoming

the type collection for the Tayacian, an industry represented in many Paleolithic sites throughout the Old World. New excavations, which took place from 1994 until 1998, were designed to shed more light on the archaeological context of the hominid remains and the nature of the Tayacian itself.

While the analysis is still in progress, the preliminary results suggest that the formation of the Tayacian layers, with its associated industry and hominid fossils, was more complex than previously thought. A combined topographic mapping and electro-resistivity study of the surface around and immediately above the cave indicates the presence of a chimney in the rear of the cave. This chimney appears to have been the source of the Tayacian sediments and potentially the industry as well. In general, the stone tool industry is quite poor with a very low density of artifacts and a high percentage of damaged and rolled pieces. The tools are dominated by tool types that could be the result of post-depositional process. In addition, there are abundant nodules of raw material eroding from the cave wall. This mix of taphonomic factors makes it extremely difficult to delineate and define a Tayacian industry at the classic type site and calls into question the archaeological context of the fossil hominids.

The Pretoria Collection: A new source of documented skeletal material in South Africa. J. H. MEIRING, S. R. LOTH, and M. LOOTS, Anatomy (Medicine), University of Pretoria, 0001, South Africa

A large assemblage of skeletons with documentation of demographic characteristics is the most valuable source of data for scientists who study bones. Yet there are only a few well established collections in the world and of these, only one is still actively expanding. Thus, we are pleased to announce that preparations are in progress to make the Pretoria Collection readily accessible to researchers. Housed in the Department of Anatomy in the Faculty of Medicine at the University of Pretoria (South Africa), the collection consists of remains from nearly 800 adult cadavers. During the initial phase of collection, the aim was merely to provide teaching materials, and little effort was made to preserve entire skeletons. Realizing the value of saving complete remains, Department Head, Prof JH Meiring, initiated procedures to do so in 1987. At the beginning of 1998, he appointed the senior author (SRL) as Collection Director and allocated a large hall for the curation and study of the skeletal materials. At present, only cranial remains are easily accessible. A request for funding has been made for renovations that will make the entire collection available to established researchers and registered graduate students from around the world (following approval of a research protocol).

The dissected cadavers from which the skeletons are macerated, derive from two main sources: unclaimed bodies from local hospitals, and donations. Records contain information drawn from identity documents and

include age, dates of birth and death, sex, race, tribal affiliation, and cause of death. An inventory, (computerized by ML) is under way, and currently, 672 complete crania, 527 of which have mandibles, and the postcranial skeletons of 464 individuals have been tallied. Demographic distribution is uneven - black males predominate, followed by a large number of white males, and far fewer white and black females. Like the nearby Dart Collection, the Pretoria Collection is still expanding, and is expected to grow at the rate of at least 50 complete skeletons per year.

PMS: A bioculture-bound syndrome. M.K. MELBY and E.O. SMITH, Department of Anthropology, Emory University, Atlanta, GA 30322

PMS has traditionally been seen either as a solely biological phenomenon requiring a medical, technological fix or as a predominantly culture-bound syndrome. PMS is linked to the reproductive endocrine system, the target of thousands of generations of strong selective pressure. Therefore we use a Darwinian approach to generate several hypotheses about PMS.

These hypotheses are difficult to test given the dearth of cross-cultural data. However, the focus on the menstruum instead of premenstruum in most non-Western societies may provide clues to the etiology of PMS. Evolutionarily, as well as contemporarily in non-Western cultures, human females were unlikely to experience menstruation (and thus the premenstruum) very frequently. Long periods of pregnancy and post-partum amenorrhea punctuated by brief periods of reproductive cyclicity characterize the evolutionary milieu of human reproduction. Many non-Western women today are also characterized by similar reproductive patterns.

The reproductive histories and hormone profiles of many Western women appear to be evolutionary anomalies. We argue that cultural factors contributing to changes in diet, workload, exercise, and reproductive patterns may have caused PMS to become biologically and culturally salient for many women. An evolutionary perspective allows us to consider that PMS may be a result of a discordance between biology and the current environment. The puzzling question then becomes not why do certain populations seem aware of PMS, but why do only subsets of those populations seem to experience PMS? To answer this question we must return to culture, and create a biocultural framework in which to understand PMS.

Evaluation of alleged Sasquatch footprints and inferred functional morphology. D. J. MELDRUM, Dept. Biological Sciences, Idaho State University, Pocatello, ID 83209-8007.

Throughout the twentieth century, reports of giant apes have emanated from the montane forests of the western US and Canada, commonly referred to as Bigfoot or Sasquatch. Hundreds of large humanoid footprints have been discovered, many of these have been photographed or preserved as plaster casts.

Fresh footprints were examined first-hand in 1996 in the Blue Mountains of southeastern Washington. Subsequently, a sample of over 100 original footprint casts and over 50 photographs of footprints and casts were examined. Many of these tracks indicate the action of an animate foot as opposed to an artificial prosthesis. Surface detail reveals skin print patterns, dermatoglyphics and flexion creases. In some instances, particular individuals have been repeatedly identified in a given geographical area over considerable periods of time. Footprints in series display apparent variation in plantar pressure, toe movement and midfoot flexion/rotation appropriate to substrate conditions and inferred locomotion. Consistent distinctions of morphology are evident in these footprints that contrast to human feet. They reveal consistently longer relative toe lengths and greater range of abduction, especially in the hallux. There is a lack of a fixed longitudinal arch. Instead, the transverse tarsal joint is quite flexible, as indicated by "half-tracks" and pressure ridges. Accordingly, the heel segment is relatively elongated. This morphology would appear to combine features of both propulsion and prehension, well adapted to the habitat of rugged expansive montane forests, and correlates with the purported massiveness of body and with the compliant gait reported by eyewitnesses and evidenced in the footprints themselves.

This research was partially supported by Grant No. 780 from the ISU Faculty Research Committee.

Congenital and Early Developmental Defects of the Skeleton: Their Identification and Significance in Native North Americans. C. F. MERBS, Department of Anthropology, Arizona State University, Tempe, AZ 85287-2404.

Serious congenital skeletal defects such as anencephaly and spina bifida aperta were undoubtedly rare in antiquity, resulting in death at full term or before. Few examples have been identified in the archaeological record, and ethnographic sources suggest that they were selected

against by cultural beliefs and practices as well as by natural factors. Even less serious conditions, though more difficult to identify and assess, were likely subjected to survival pressure, thus contributing to the total picture of infant mortality in ancient populations.

This study examines the presence and frequency of developmental defects, their role in determining infant survival, and their overall effect on the individuals in which they occurred. In particular, the study examines these conditions in the skeletons of native North Americans, from the Arctic to the present Mexican border. Included are defects that appear to be essentially systemic in nature, defects of the axial skeleton, especially those reflecting neurological and vascular development, and defects of the appendicular skeleton, particularly the hands and feet.

Cremated human remains from a fourteenth century Iroquoian village.

D.C. MERRETT, Dept. of Human Biology and Nutritional Sciences, University of Guelph, Guelph, Ontario, Canada, N1G 2W1.

Although skeletal samples from Iroquoian ossuary (Pfeiffer & Fairgrieve 1994) and non-ossuary (Saunders & Spence 1986) burials have been extensively studied, not all Iroquoian mortuary practices documented by seventeenth century Jesuits are represented in the existing archeological record. In particular, although cremation is noted by the Jesuits, skeletal evidence of human cremation from southern Ontario Iroquoia is scant (Dodd, et al. 1990).

This research reconstructs aspects of culturally-prescribed mortuary behavior through the analysis of 1056 grams of cremated human skeletal remains from a single in-house non-ossuary burial. The site, Serena (Ah Gx-274), a southern Ontario Iroquoian village is dated to the early fourteenth century.

The cremains contain a minimum of two middle-aged adults of overall similar size and rugosity. At least one and possibly both are female. The variation in color and in the pattern of cortical exfoliation among and within skeletal elements suggests that the two individuals were in different stages of decomposition prior to cremation. The total weight for at least two adults indicates that not all of the remains were transferred from the crematorium to the burial site. The analysis of the Serena site cremains enlarges the archeologically documented spectrum of prehistoric Iroquoian mortuary practices and illustrates the importance of small skeletal samples in elucidating culturally-influenced behavior in past populations.

I greatlyfully acknowledge ASI, Inc., without whom this research would not have occurred.

Ethnobiology by Mayangna Indians in Bosawas Reserve, Nicaragua: An example of community directed conservation. J.C. MERRIAM, Departments of Anthropology and Biology, Idaho State University, Pocatello, ID 83209.

Efforts to involve communities in conservation of their natural resources often address problems defined externally and are therefore irrelevant to participants. In July-August 1998, the Mayangnan community of Amak identified the lack of written information about locally important fish and wildlife species as a barrier to their conservation goals. The community then collected and transcribed ethnobiological data for 48 species of mammals, birds, fish and reptiles.

This example of community directed conservation is part of a larger project initiated in 1993 by the Nicaraguan government, USAID and The Nature Conservancy in Nicaragua's Bosawas Reserve. Populated by 13,000 indigenous people, the leaders of the reserve's five territories defined management plans for different ecological use zones. In 1997, the community of Amak began to monitor their fishing and hunting practices with the assistance of this investigator. In July 1998, a workshop based on the monitoring data was conducted to evaluate the territories' hunting and fishing management plan.

In the evaluation process, community leaders decided written biological information would provide a critical reference for future conservation plans and a valuable educational tool. Experts in hunting and fishing were assembled from the village; male hunters described the habits and conservation statuses of important mammals and birds. A similar process involved women anglers who described aquatic species.

This example of self-documented ethnobiology by an indigenous group is a method that can be used in other areas to generate an information base from which indigenous communities can formulate conservation objectives. Additional relationships between indigenous hunting practices, land use patterns and conservation are discussed.

Funded by The Saint Louis Zoo, with assistance from The Nature Conservancy and Idaho State University.

Native American Origins and Dispersal: Evidence from Mitochondrial DNA. D.A. MERRIWETHER, B. KEMP, AND J.V. NEEL, Departments of Anthropology, Biology and Human Genetics, University of Michigan, Ann Arbor, MI 48109-1382

Mitochondrial DNA data has been used to argue for different scenarios for the peopling of the New World since 1988 (Wallace et al., 1986), and has been used to argue for 2-3 waves of migration (Torroni et al., 1992; 1993; 1994) and one wave of migration (Merriwether et al., 1995; 1996; Kolman et al., 1996) using RFLP and D-loop sequence data. These scenarios have expanded from the initial idea of only a few founding lineages entering the New World, to a more expanded set of lineages entering. The continuing debates revolve around the actual number of founding lineages that entered the New World, the number of waves of migration, and the origin of the founding population(s). While the number of likely migrations has crept down to just two or one, it is fairly widely agreed that they came from

just one source population on the other side of the Bering Strait somewhere. The origin of the source population is also still in debate, with the two main contenders being the Mongolians and the Chukchi. The number of founding lineages and founding haplogroups has slowly been added to, so that virtually everyone concurs that more than just A,B,C, and D entered the New World, and most concur that multiple variants of at least some of the lineages entered together. The nature and defining mutations of these "new" putative founding lineages are still being debated.

We present evidence from RFLP data on over 2000 Native Americans and over 500 D-loop sequences, included 129 recently sequenced Yanomami mtDNAs to argue for a single wave of migration, from the region of Mongolia (at least Mongolians are descended from the same parent population as New World founders). We present evidence from both RFLP and sequence data for at least two variants each of A and D entering the New World. We also present evidence for additional Asian-specific lineages (designated X6 and X7) that are widely distributed in the New World indicating that they entered with the founding populations. We concur with Forster et al., (1998) that most of these lineages probably originally derived from the loss of the C and D defining RFLP sites (actually gains at *Hinc II* 13259 and *Alu I* 5176). Since they are widespread, we argue that these losses predated entry into the New World.

Lastly we present evidence for the levels of mitochondrial gene flow between and within various Native American populations using both the cladistic and FST approaches to gene flow estimation.

A re-examination of a proposed Neandertal maxilla from Ksar 'Akil Rock Shelter, Antelias, Lebanon. M.C. METNI, Department of Anthropology, Kent State University, Kent, OH 44242.

Excavations at the Paleolithic rock shelter site of Ksar 'Akil in the Antelias River Valley of Lebanon began in 1937 under the direction of J.G. Doherty. H. Movius and J.F. Ewing joined the expedition in 1938. Human remains from three separate individuals were recovered from the site during these two field seasons: one partial skeleton, a few fragments of a calvarium, and a partial maxilla. Upon further investigations by Ewing, the skeleton and calvarium were dismissed as modern *Homo sapiens*. However, the fragmentary maxilla was described as exhibiting Neandertal-like traits based upon comparisons of the measurements of the palatal breadth at M1, nasospinale to prosthion, bicanine breadth, and M1 dimensions of the Ksar 'Akil maxilla to those of Tabun I, Skhul IV, Skhul V, Gibraltar and the Chapelle-aux-Saints specimens (Ewing, 1963).

This project demonstrates that Ewing's conclusions regarding the Ksar 'Akil maxilla were not scientifically supported. First, and most importantly, all of the measurements of the Ksar 'Akil maxilla fall within the range of modern human variation, something which Ewing did not take into account. Furthermore, Ewing stated that the Ksar 'Akil maxilla most closely resembles that of Skhul V, which, at the time was thought to be a Neandertal. At present, it is commonly agreed that Skhul V is a modern human.

Also, Ewing mistakenly estimated the size of the missing M1 of the Ksar 'Akil maxilla from the size of the remaining alveolus, and his estimate did not correspond to his other measurements on that specimen. He estimated that the M1 would have been the largest amongst the sample group, while all of the other measurements of the Ksar 'Akil specimen are the smallest amongst the sample group. A large part of Ewing's argument rests on the large size of this missing M1. Even with a large size estimation, the Ksar 'Akil maxilla still falls within the range of modern human variation.

Based on the information available to him at the time, Ewing went beyond the evidence to claim that the Ksar 'Akil maxilla was that of a Neandertal. It is equally as likely that the maxilla is that of a modern human.

War and population change in Finland. J.H. MIELKE, Department of Anthropology, University of Kansas, Lawrence, KS 66045.

Fluctuations in population size and structure were often characteristic features of past societies. Famines, epidemics, and wars were the three most pivotal precipitating factors in population crises. During crises, demographic parameters often deviated greatly from their typical levels, changing the composition of the population. Understanding the dynamics of these types of crises and unraveling their short- and long-term effects is a challenging endeavor.

Using archival data from Finland and the Åland Islands, this paper assesses the population changes and ramifications caused by the War of Finland. Mortality during the war was intense and varied from region to region. The average mortality rate for the whole of Finland was 60 per 1000 population. In the 31 ecclesiastical administrative units mortality varied between 35 and 107 per 1000. During the war the population in Finland was reduced about six percent, while the Åland Islands suffered a 13% loss. The highest rates and the timing of the mortality peaks largely correspond to both the presence and extent of activities of the military forces in the area. These factors included the location of troop concentrations, their movements, state of health, and extent and intensity of contact with the surrounding civilian population.

This presentation further examines the differences between the pre- and post-war population structure and the post-war recovery demonstrating that population crises do not have to last very long in order for them to result in large population losses. Post-crisis population growth was tempered by social customs and age-specific mortality during the war period. The general trends that emerge from this study can hopefully help illuminate situations where less detailed archival data exists.

Thanks are extended to Kari Pitkänen, Helsinki, Finland, and Bjarne Henriksson and his staff at the Landskapsarkivet, Mariehamn, Åland. Supported by grants from the Sigrid Jusélius Foundation, Helsinki, Finland; and NSF (BNS-8319057 - JHM & DBS-9209262 - Lynn Jorde).



Enamel microdefects as indicators of socioeconomic affiliation in a modern sample. L.M. Mifsud, Department of Anthropology, University of Tennessee, Knoxville, TN 37996

Developmental enamel defects have been incorporated into research conducted by paleopathologists, bioarchaeologists, and dental anthropologists in an effort to determine health conditions, physiologic stresses, and specific cultural practices (i.e., age of weaning and socioeconomic affiliation) of past and present populations. A majority of the research on contemporary groups indicates an association between macroscopic enamel defect frequencies, inferior living conditions, and episodes of morbidity. This study investigates the association between microscopic enamel defects, termed Wilson bands, and socioeconomic affiliation in a contemporary sample.

The sample (N=114) consists of maxillary and mandibular canines and incisors from men and women of European-American descent. Teeth were collected from nine public health clinics and private practice oral surgeons in Tennessee and California. For the purpose of this study, socioeconomic affiliation is based on collection locale. As a rule, individuals frequenting the public health facilities are assigned to a lower socioeconomic standing than those who visit private practice oral surgeons. The presence or absence of a Wilson band is recorded for each tooth in the sample. Teeth collected from the public health department manifest Wilson bands in 42% of the teeth. Teeth from private practice locales manifest Wilson bands in 24% of the teeth.

However, when Wilson band frequencies are plotted in a Chi-square contingency table by collection locale, and a separate test conducted for each tooth type (i.e., mandibular canines, lateral and central incisors and maxillary canines, lateral and central incisors), the results deviate somewhat from what is expected. The Chi-square results ( $\alpha=0.05$ ) indicate that a majority of the teeth demonstrate no relationship between Wilson band frequency and socioeconomic affiliation. Although, this is not the case for the mandibular central incisors, which indicate (with a probability of 0.01) that a relationship exists between Wilson band frequency and socioeconomic affiliation. This study addresses the implications of Wilson band sensitivity as it pertains to socioeconomic affiliation.

Temporal trends in morbidity in the Chesapeake Bay area: Part two. Data and conclusions. E. MILLER, California State University, Los Angeles, CA, 90032, F.E. DAMANN, Louisiana State University, Baton Rouge, LA, 70803, D.H. UBELAKER and E.B. JONES, National Museum of Natural History, Smithsonian Institution, Washington, DC, 20560.

Approximately 700 individuals recovered from ossuary contexts at nine archaeological sites in the Chesapeake Bay area of Maryland and Virginia were studied to show temporal patterns of health in ancient populations of Maryland and Virginia. The nonspecific health indicators used in this study were: porotic hyperostosis, cribra orbitalia, caries, abscessing, enamel hypoplasia, antemortem tooth loss, forearm trauma, periosteal

reaction, and spondylolysis. The nine sites were divided into five temporal units: Early Woodland, Middle Woodland, Late Woodland, Protohistoric and Historic. Data from specific sites falling within each time period were combined into these time-categories to increase sample size for statistical purposes.

Preliminary analyses of the data indicate no statistical differences in the occurrence of these health indicators over time within the study region. This apparent lack of change in health was unexpected, as it is known that reliance on agriculture increased in the Chesapeake Bay area from the Early Woodland into Historic times. It is also somewhat puzzling that health did not apparently change over time in this area due to the political pressures caused by the encroachment of northern Native groups into the area, driven south by the "League of the Iroquois," and the strong push up from the south by the Powhatan Confederacy. It is suggested that chronic health problems did not increase during the late prehistoric, protohistoric, and early historic time periods because of the relatively strong political and economic climates in which these Native groups of Maryland and Virginia lived.

Modeling hominid locomotion: biomechanical influences of Neandertal pelvic morphology and anatomical orientation. J.A. MILLER, Department of Anthropology, and M.M. GROSS, Center for Human Motor Research and Division of Kinesiology, University of Michigan, Ann Arbor, MI 48109.

Neandertal pelves display marked morphological differences compared to recent humans. The effect of these skeletal differences on locomotor output also depends on the anatomical orientation of the pelvis. It is not known, however, whether pelvic orientation in Neandertals was the same as in recent humans. The purpose of this study was to determine whether dissimilarities in morphology and orientation between pelves from Neandertal and recent human samples reflect significant biomechanical differences that would affect locomotion. Preliminary results were previously reported (Miller and Gross, 1996).

An interactive computer graphics-based program (SIMM; Musculographics, Inc.) was used to quantify Neandertal and recent human musculoskeletal geometry. Recent human pelvic morphology was modeled by scaling a generic model to represent very large (European-Americans), large (African-Americans) and small (Inuit) skeletal samples. The Kebara 2 hemipelvis was digitized to create a model of a Neandertal pelvis; a femur from the generic model was scaled to reflect Neandertal proportions. The Kebara 2 hemipelvis was then rotated through a range of twenty-five degrees to test sensitivity of biomechanical output to pelvic orientation. Muscle attachment sites were located on all models for twenty muscles that span the hip. Muscle moment arms and moments were calculated for the entire range of hip flexion, extension, abduction and adduction.

Neandertal moments were within the range of recent human moments with the exception of Neandertal flexion moments, which were greater than those of all recent human models. Although biomechanical output in the Neandertal models was highly sensitive to pelvic orientation, changing the orientation of the pelvis did not place Neandertal

moments outside of the recent human range. These results suggest that Neandertal advantages in locomotor capacity, if they existed, would have been derived primarily from muscle characteristics and pelvic morphological differences rather than from pelvic orientation.

Effect of analog choice on comparative morphometric relationships among fossil hominids. J.M.A. MILLER, G.H. ALBRECHT, University of Southern California, Los Angeles, CA 90033, and B.R. GELVIN, California State University, Northridge, CA 91330.

Morphometric studies among fossil hominids rely on comparisons with modern species. Controversy exists as to which modern analog species are appropriate for establishing the comparative framework for interpreting variation among fossils (e.g., humans vs. chimps vs. gorillas). We believe the concept of analogs should be broadened to include samples that reflect various levels of hierarchical variation within a species. For example, comparisons might be based on single sex samples of adults from a single locality rather than the usual practice of using small, poorly controlled, species-level samples. After all, each fossil is certainly a member of a single sex of a local population just as it is a member of a species. We investigated how both the choice of an analog species as well as the hierarchical level of samples used to represent that species affect morphometric relationships among fossil hominids.

Our analog samples were derived from W.W. Howells' modern human craniometric data and Colin Groves' gorilla craniometric data. For modern humans, 16 variables were used for 2,416 adults representing males and females from 26 local populations. For gorillas, 18 variables were used for 606 adults representing males and females from 150 localities for the 3 subspecies. We measured the same variables on a variety of fossil hominid casts. Ordination of the individual fossils, which were entered directly into the analyses, was based on unweighted canonical variate analyses (CVA; Albrecht, 1992, *Hum. Evol.*, 7: 49-69).

Fossils were ordinated using CVA's based on different levels of intraspecific sampling for different analog species. Our results show that the pattern and degree of dispersion among fossils is dependent on the differing nature of the variation within the different analogs. For example, relationships among fossils differ depending on whether the CVA is based on same-sex or combined-sex locality samples of highly variable, highly dimorphic gorillas versus similar samples of less variable, less dimorphic humans. Other factors that affect morphometric relations among fossils include choice of variables, corrections for size and shape, and homogeneity of analog samples.

Our results have implications for any fossil study that uses analogs for comparative purposes whether it be for species recognition, the determination of higher-order taxonomic relationships, or answering other questions involving interpretations of morphological resemblance.

The function of uncinat processes among primates. N. MILNE and C. E. OXNARD, University of Western Australia, WA, 6907, Australia.

The function of uncinat processes found on the cervical vertebrae of primates, marsupials, bats and rodents has

been the subject of debate for some time (eg Hall, 1965, Luschka's Joint, Thomas, Springfield). Recent studies of motion in the cervical spines of humans, kangaroos, dogs and horses, revealed much about the roles of the zygapophyseal facet joints in controlling movement. However, the presence or absence of uncinat processes did not affect the overall mobility available in each neck. These processes do, however, affect motion in a more subtle way, moving the location of the axis of movement into a more stable position. This suggests that their role might be postural rather than dynamic. Furthermore, the observation that all species with uncinat processes also have a clavicle has lead to a new hypothesis that uncinat processes are found in clavicate mammals that use their forelimbs for grasping and manipulation. The idea is that uncinat processes help brace the neck against unwanted actions of shoulder-neck muscles when these are used for positioning and supporting the shoulder.

More recent studies of the size, shape and orientation of these processes in a diverse range of South American rodents supports this hypothesis. Those species that manipulate their food in their hands (eg agouti) have well-developed uncinat processes; those which are more simply quadrupedal (eg capybara) have poorly developed uncinat processes. Among primates there is a wide range of uncinat process development with langurs, vervets, baboons and spider monkeys having the largest relative uncinat processes, and orang utans, lemurs, gorillas and humans the smallest. The meaning of this pattern of variation is not as clear among primates as it is among rodents and marsupials. The possibility exists that among primates there are one or more other confounding factors. One may be the effect of somewhat more orthograde postures than in other mammals (an old idea). Another may be the primate propensity for communication through head, shoulder and arm positioning. There may even be a complex relationship to the overall sizes of the animals. Supported by Australian Research Council and Centre for Human Biology, University of Western Australia.

A deletion polymorphism in the  $\alpha 2(1)$  collagen gene (COL1A2): genetic evidence for a non-African population whose descendants spread to all continents. R.J. MITCHELL, N.G. WHITE, La Trobe University, Melbourne, Australia, M.H. CRAWFORD, J. McCOMB, University of Kansas, Lawrence, KS, C. TYLER-SMITH, University of Oxford, UK, S.S., PAPIHA, University of Newcastle, UK, and M.S. SCHANFIELD, AGTC, Denver, CO

This study reports upon the worldwide frequency of a 38 bp deletion polymorphism (in the COL1A2 gene) and argues this distribution has major implications for understanding the evolution of modern humans immediately after the exodus from sub-Saharan Africa and their subsequent spread to all continents. We demonstrated that this polymorphism arose from a deletion event by scoring a number of higher primates to ascertain the ancestral status of the locus. Deletions are thought to be rare evolutionary events, and large deletions, such as this one, have probably occurred only once. We scored the COL1A2 polymorphism in a total of 219 individuals drawn from 10 populations distributed in all geographical areas except Europe to add to the data already in the literature. Among these populations were hunter-forager

groups (San, Australian aboriginal people, and Kets of Siberia) as well as native Americans from both N. and S. America, and indigenous groups of Siberia (Evenki and Altai). The relatively high frequency of the deletion in all non-'Black' African populations (~20%) and its absence in 'Black' Africans strongly suggests the deletion event occurred after modern humans left sub-Saharan Africa. Further, these data are consistent with the view that the deletion most probably evolved shortly after the African exodus, and, most interestingly, that the descendants of the migrant group in whom the deletion event occurred were among the ancestors of all contemporary world populations, other than 'Black' Africans. These observations do not imply there was a single migration out of Africa, but do suggest there has not been extensive migration back to Africa.

Another polymorphism that arose from a point mutation in the GM immunoglobulin system displays a similar distribution to that of COL1A2; haplotype GM\*A, X G is present in all human groups except 'Black' Africans among whom it is absent (except for known admixture). The contemporary distributions of these 2 markers suggest there may not have been a rapid diaspora of modern humans to the rest of the world immediately on exiting Africa but, instead, the savannah adapted migrants' gene pool may have had to pause in the new environment in order to adapt to novel selective agents such as bacteria, viruses and other xenobiotics.

**Familial Trigenocephaly in Rabbits.** M.P. MOONEY, G.M. COOPER, A.M. BURROWS, W. WIGGINTON, T.D. SMITH, J. DECHANT, H.W. LOSKEN, M.I. SIEGEL, Depts. Anatomy & Histology, Anthropology, Plastic Surgery, Univ. Pittsburgh, and School of Physical Therapy, Slippery Rock Univ., Slippery Rock PA.

Previous studies from our laboratory have characterized the craniofacial morphology and growth patterns of an inbred strain of rabbits with autosomal dominant coronal suture synostosis. A number of rabbit perinates from this colony have been collected sporadically over a five year period with premature interfrontal suture synostosis. The present study describes the craniofacial morphology of these rabbits and compares them to normal control rabbits. Forty perinatal New Zealand White rabbits were used in the present study. Twenty-one rabbits had interfrontal suture synostosis and ranged in age from 27 to 38 days postconception (term=31 days) with a mean age of 33.53 days (+/- 2.84 days). Nineteen rabbits served as age-matched, normal controls (mean age = 33.05 days +/- 2.79 days). CT scans and Lateral and dorsoventral radiographs were collected from each rabbit. Intracranial volume (ICV) was calculated from the CT- 3D reconstructions. The radiographs were traced, computer digitized, and 12 craniofacial measurements, angles, and indices were obtained. Mean measures were compared using an unpaired Student's t-test. All synostosed rabbits were stillborn or died shortly after birth. Grossly these rabbits exhibited extreme frontal bossing, trigonocephaly, and midfacial shortening. No somatic anomalies were noted. ICV was significantly ( $p<0.05$ ) reduced (by 10%) in trigonocephalic perinates compared to normal controls. Radiographically, rabbits with interfrontal suture synostosis had significantly ( $p<0.05$ ) narrower frontal bones, shorter head lengths, and kyphotic cranial base angles. Also significantly ( $p<0.05$ ) different cranial vault indices (shapes) were noted compared to controls. Results reveal severe pathological and compensatory cranial vault changes associated with premature interfrontal suture synostosis in this rabbit model.

The 100% mortality rate noted in this condition may be related to neural compression from reduced intracranial volume, although a detailed pathological study of the brain is needed to validate this hypothesis. Supported in part by NIDR (DE010830), NIAMS (AR44172), March of Dimes Birth Defects Foundation (FY96-1050), Cleft Palate Foundation (CPF), and Plastic Surgery Educational Foundation (PSEF).

**Functional morphology of the cranio-orbital region in *Theropithecus brumpti*: Taxonomic and phylogenetic implications.** W.D. MOORE, B.R. BENEFIT and M.L. McCROSSIN. Department of Anthropology, Southern Illinois University, Carbondale, IL 62901.

This study investigates adaptive and phylogenetic implications of the highly unusual cranio-orbital specializations of *Theropithecus brumpti*. The orbits of *T. brumpti* (and to a lesser degree *T. baringensis*) are positioned very high on the face and rise above the neurocranium, similar to those of aquatic animals such as hippopotami and crocodiles. In addition, *T. brumpti* orbits are strongly compressed apically at the posterior part of the ethmoid region that connects with alisphenoid and orbitosphenoid. The interorbital septum is extremely thin and the orbits highly apposed, unusual features for an animal with such small orbits relative to skull length (Moore 1997, 1998).

Rather than being adapted for an aquatic life-style, the unique cranio-orbital morphology of *T. brumpti* may be part of a larger suite of adaptations related to high masticatory stresses generated during the consumption of a possible mixed folivorous-graminivorous diet. The high position of the orbits on the face is likely related to two factors, a) having an elongated muzzle, and b) the protection of the orbital contents from laterally directed high masticatory stresses (cf. Ross, 1995ab, 1996).

Using the parsimony algorithm in PAUP and the analysis of character evolution function in MacClade, we examine a suite of qualitative and quantitative cranio-orbital characters for extant and fossil papionins. Based on the specialized relationship between the cranio-orbital region and the masticatory apparatus in *T. brumpti sensu stricto*, our results suggest that at the very least an inclusion of this taxon in its own subgenus may be warranted (cf. Leakey, 1993). It is also likely, based on our data, that *T. brumpti* is more closely related to *T. baringensis* than either is to *T. quadratiostris*. This lineage does not appear to be as closely related to extant *T. gelada* as is the *T. darti-T. oswaldi* lineage.

**Morphometric variation and sex determination in the human sacrum.** P.H. Moore-Jansen and J.H. Plochocki. Department of Anthropology, Wichita KS 67260-0052.

A number of past and present inquiries into the morphometric variation of the human sacrum are

available in the literature, specifically for the purpose of sex estimation of unknown skeletal remains. Most research has focused on the obvious dimensions of height and breadth and, although alluded to, few investigations have examined the overall size and shape of the sacrum, including a morphometric detailing of the sacral curvature. In the present study, the authors explore the potential for using a comprehensive metric assessment of the sacrum in the estimation of sex and general evaluation of sex and group variation.

A total of 27 measurements were recorded on a sample of 228 sacra of Black and White cadaver specimens from the R.J. Terry collection housed at the Smithsonian Institution, Washington, D.C. The measurements include breadths and lengths, but also include a series of new chords and subtenses along the anterior length. Their purpose is to more fully identify the potential significance of sacral curvature in studies of sexual dimorphism and group variation.

In addition to the descriptive morphometric study of the sacrum, a stepwise discriminant procedure with a MAXR option is carried out to identify optimal models for estimating sex. Our findings suggest a strong group specific pattern of sexual dimorphism in the sacrum, and preliminary results reveal a high accuracy of sex estimation among female sacra (96% in Black females; 88% in White females). Male classification is poor in both groups (58% in Black males; 53% in White males). The discrepancy observed here is discussed further in light of sample variation and general anatomical variation.

Areas of Genetic Endemism (AGE) in Southeast Asian Primates. J.C. Morales<sup>1</sup>, D.J. Melnick<sup>1</sup>, M.R.J. Forstner<sup>1</sup>, L.L. Rosenblum<sup>1</sup>, B.J. Evans<sup>1</sup>, A.J. Tosil<sup>1</sup>, W. Wang<sup>2</sup>, N. Andayani<sup>3</sup>, J. Supriatna<sup>3</sup>, and M. Nordin<sup>4</sup>. <sup>1</sup>CERC and Anthropology Dept., Columbia University, New York., <sup>2</sup>Kunming Institute of Zoology, <sup>3</sup>CBCS, University of Indonesia, and <sup>4</sup>University Kebangsaan, Malaysia.

Through molecular analyses, an international group of researchers associated with the Center of Environmental Research and Conservation (CERC), have estimated phylogenetic relationships, geographic distribution of genetic variation, and units of conservation in three broadly distributed radiations of southeast Asian Anthropoid primates: macaques, leaf monkeys and gibbons. Using both phylogenetic and population genetic models, we have also defined genetically based intraspecific management units within the geographic ranges of the Javan gibbon, silver leaf monkey, pig-tailed macaque, and Sulawesi macaques. In doing so we have begun to delineate Areas of Genetic Endemism (AGE) in southeast Asia and to establish a basic understanding of the behavioral ecology and biogeography of genetic discontinuity in large mammals in

southeast Asia. This, in turn, has provided us with an objective set of measures upon which to base population, species and regional wildlife management and conservation policy decisions. This research has been funded by U.S. National Science Foundation (grant #9707883), and by the John D. and Catherine T MacArthur Foundation.

Morphological Continuity in African *Homo*, UA 31 considered. T.T. MORROW, Department of Anthropology, University of Michigan, Ann Arbor, MI 48109

UA 31, a well preserved, nearly complete cranium from the Buia section of the Danakil (Afar) Depression in Eritrea, has been dated at about 1 Myr before present. As such it illuminates the previously poorly represented period of *Homo* cranial evolution between 1.4 and 0.6 Myr in Africa. The exact classification of this specimen is of the greatest interest for those who hold that there are several speciations leading up to *Homo sapiens*, most interestingly the development of *Homo erectus* out of *Homo ergaster* and *Homo antecessor*, which is may have occurred at this time.

Using published morphometric data and photographs of UA 31, several areas of cranial anatomy were compared with casts of WT 15K and ER 3733 as earlier specimens and Ndutu as a more recent specimen of crania with faces, in order to determine the degree of affinity between these specimens, and develop a clearer pattern of evolution in Africa of *Homo*.

It has been noted that UA 31 is a mixture of *H. erectus* and *H. sapiens* characteristics. Particularly that the high position of the greatest biparietal breadth and the elongated occipital plane are indicative of a more recent *H. sapiens*-like development (Abbate et al., 1998). However, the varied similarities with earlier remains does not warrant a different taxonomic classification and suggests that UA 31 lies along a continuum of hominid evolution in Africa, which leads from earlier to more modern forms with out speciation.

Web-based instruction in biological anthropology. D.M. MULHERN, NMNH, Smithsonian Institution, Washington DC 20560.

Instruction on the world wide web is quickly becoming an integral part of the college curriculum. This forum can potentially provide a unique resource for students of biological anthropology. Courses in biological anthropology can be adapted to this medium in a variety of innovative ways.

A new osteology course offered by the Continuing Education Department at the University of Colorado at Boulder was developed to provide introductory students worldwide with the opportunity to study a Medieval skeletal collection from Sudanese, Nubia that was previously accessible



for research only. Students utilize a gallery of over 200 photographs integrated with lectures, tutorials and exercises to learn the basic techniques of human identification. In addition to learning methods used to conduct skeletal inventory, determine sex, estimate age at death and identify pathology, students learn specifically about the Medieval community of Kulubnarti, Nubia. Access to this course is not limited to registered students, so anyone can access the photographs to study the Nubian collection.

For the past two years, students have performed well and responded positively to the course. A continuing rise in national and international student interest underlines the need to further develop online instruction in biological anthropology. Colleges and universities can now provide access to their skeletal collections that has been previously restricted or unavailable. Students of biological anthropology will benefit from the increased opportunity to study skeletal collections from institutions worldwide.

Paternal investment in the monogamous fat-tailed dwarf lemur (*Cheirogaleus medius*) in northwestern Madagascar. A.E. MÜLLER, Anthropological Institute, University of Zürich, CH-8057 Zürich, Switzerland

The strictly nocturnal dwarf lemurs, genus *Cheirogaleus*, are unusual among primates for extended torpor phases during the dry season which are thought to be an adaptation to seasonal variation in food availability. The fat-tailed dwarf lemur, *C. medius*, may stay in torpor for 6-8 months. To survive such long periods, the animals store fat and as a result show extreme seasonal variation in body weight. In a 20-month study, carried out at the Forestry Station of Ampijoroa, *C. medius* was found to live in a monogamous social system (Müller, 1998).

In this paper I present results from that study on body weight variation in repeatedly trapped *C. medius* individuals to improve understanding of the biology, social life, and sex specific roles of *C. medius* males and females. A very remarkable characteristic was the drastic weight-loss in adult males in September following emergence from torpor. Trapping results showed that adult males emerge from torpor earlier than females and offspring. Early emergence of torpor puts males at an energetic disadvantage and confers no advantage in terms of access to females. Observation data from night follows indicate that males patrol a home range, thus guaranteeing their integrity for the coming active season and ensuring a good food supply for their families. Such male behavior increases the likelihood of his offspring and that of his mate's survival. At the same time it optimizes his mate's reproductive success and thus his own reproductive potential. The high energetic costs of this strategy is argued to represent a form of paternal investment.

Supported by the A.H. Schultz Foundation, the Family Vontobel Foundation, the Goethe Foundation, the G. & A. Claraz Donation and the Swiss Academy of Natural Sciences.

Dental pathology and stable isotope analysis: dietary implications for the site of Ingombe Ilede, Zambia. K.A. MURPHY, Indiana University, Bloomington, IN 47405.

The Iron Age site of Ingombe Ilede, Zambia is well-known in southern African archaeology because of the relatively large number of human burials (N=46) as well as gold, copper, and iron artifacts associated with a small subset of burials (N=11). Inconclusive dating precludes interpretations of status differences since contemporaneity of the two groups is questionable. Data on subsistence and settlement patterns are also lacking because only the cemetery was excavated. Dental pathology and stable carbon and nitrogen isotopes were analyzed to provide insight into subsistence strategies and possible status differences between the adorned and unadorned burials.

Adorned (N=10) and unadorned (N=30) burials were analyzed for dental pathology. No caries were found in the adorned burials and 2.5% of tooth positions exhibited antemortem tooth loss. 20/30 unadorned burials were juveniles lacking both caries and antemortem tooth loss. 3.8% of the teeth in the unadorned adults were carious and 7% of tooth positions exhibited antemortem loss.

Three adorned and eight unadorned burials were analyzed for stable carbon and nitrogen in the collagen and apatite fractions of bone. Dietary studies (Ambrose & Norr, 1993) of  $\delta^{13}\text{C}$  values in bone collagen and apatite indicate that collagen disproportionately reflects protein from the diet while apatite is more representative of the whole diet isotopic signature. Nitrogen isotopes reflect trophic level variation in foodstuffs. Results from Ingombe Ilede indicate that very little distinction exists between the adorned and unadorned groups. The whole diet of both groups is heavily influenced by  $\text{C}_4$  products (sorghum, millet, grazing animals).  $\delta^{15}\text{N}$  values for the adorned group are slightly higher than the unadorned burials but both groups are reliant on plants for the majority of their protein, and collagen  $\delta^{13}\text{C}$  values indicate that the protein is predominately derived from  $\text{C}_4$  products.

Both groups show a strong reliance on  $\text{C}_4$  plants, a lesser degree of reliance on animal products, and relatively low dental pathology frequencies regardless of whether the two groups are contemporaneous or not.

Research was supported by a Fulbright Grant and an Indiana University dissertation improvement grant.

A structural study of the neandertal face. M. MURPHY, M. GLANTZ, M. CHANG, University of Pennsylvania, Philadelphia, PA 19104 and S. ATHREYA, Washington University, St. Louis, MO 63130.

The neandertal face, particularly the nasal and mid-facial region, have been described as specialized and autapomorphic. Two hypotheses have been proposed to explain these features. One is that neandertal nasal and mid-facial morphology reflects non-mechanical forces such as cold adaptation or genetic isolation. The other identifies mechanical factors related to high functional demands placed on the anterior dentition. Before attempting to resolve this debate, specific morphological

relationships between functional complexes must be established.

The present study explores the way by which specific aspects of the nasal region co-vary with midfacial and mandibular metric and non-metric features across a sample of modern humans.

More than 20 metric and non-metric traits of the skull and mandible were recorded from a geographically diverse skeletal sample (n=180) that includes populations from the Near East, Africa, Alaska, Greenland, northwestern Europe, and the southeastern United States. The sample includes a variety of subsistence classes from different ecological zones. These data were then compiled with a sample of published neandertal and Middle Pleistocene hominine measurements. Multivariate analyses were used to establish structural and/or functional relationships between anatomical regions. In addition, relevant morphological features were compared between sub-samples to test for degree of difference between groups.

The results of this study indicate that most of the samples do not differ significantly in the nature of their relationships between nasal, midfacial, and mandibular morphologies. Moreover, these results demonstrate that the architecture of the neandertal face is better explained by relationships between the shape of the dental arch, the breadth of the cranial base, and overall cranial architecture than by behavior or ecology. This analysis suggests a need for the reconsideration of neandertal facial morphology.

The nutritional ecology of the Amazonian floodplains: Beyond the varzea/terra firme dichotomy. R. S. S. MURRIETA, University of Colorado, Boulder, CO 80309-0233.

Until recently most attempts to explain human occupation in Amazonia had been based on simplistic assumptions about its environmental limitations. Thus, a dichotomy between the two major ecosystemic units, upper lands (terra firme) and floodplains (varzea), was created. This paper aims to show that human occupation in Amazonia is and probably has always been characterized by the multiple and concomitant use of both ecosystems. For this, I will present data on food consumption of five Caboclo populations (indigenous peasants) living on the floodplains of the Brazilian Amazon. Two populations were located on Ituqui Island in the lower Amazon, nearby the city of Santarem. The other three were located on eastern Marajo Island. The consumption data were collected by 24 hours recall during seven consecutive days in the rainy and dry seasons of 1991 and 1995-1996. Most of the populations show levels of energy and protein consumption higher than international

recommendations. In addition, diet diversity is greater in populations using multiple environments in both floodplains and upper lands. I will argue that the nutritional problems found among these populations are more the result of contemporary epidemiological factors than of food intake. In conclusion, the use of multiple ecozones of varzea and terra firme has been the most successful strategy among Caboclos to maintain satisfactory levels of energy and protein intake.

This research was supported by the Brazilian National Council for Research (CNPq), Emilio Goeldi Museum, Varzea Project (IPAM/WWF/UFPa) and FAPESP.

Bioarchaeological evidence for atl-atl use in prehistory. B.L.B. NAGY Dept. Anthropology, Arizona State University, Tempe, AZ 85287-2402.

The spearthrower, or atl-atl, was widely used for hunting in prehistoric North America. At Indian Knoll, a Late Archaic period site in southeastern Kentucky, atl-atl components were a common mortuary inclusion, especially with burials of males. It is generally assumed that in this hunting-gathering society, males would have used atl-atls fairly exclusively and intensively. In order to test this assumption, three types of skeletal data were examined for indications of stress placed on the shoulder joint: osteoarthritis, musculoskeletal stress markers, and pathological changes at the rotator cuff muscle attachment sites.

Osteoarthritis of the scapular glenoid cavity surface occurred with relatively low frequency among middle-aged and older individuals (13% of males and 10% of females). However, the pattern of osteoarthritic changes on the joint surfaces differed markedly between males and females, and between the right and left side in males.

Musculoskeletal stress markers (MSM), graded levels of variability at the sites of muscle or ligament attachment to bone, also varied significantly between the sexes. Males had significantly higher scores for 37 of 39 upper body MSM. The sex difference was especially marked for several muscles associated with shoulder strength and stabilization, such as *pectoralis major*, *latissimus dorsi*, and the rotator cuff muscles. Additionally, several of these MSM had significantly higher scores for the right side among males.

Finally, pathological changes were noted at the sites of rotator cuff muscle attachment, probably the result of acute and/or chronic musculoskeletal trauma. These changes were observed in 30% of adult males but only 3.5% of adult females. Among those males affected, 94% of the cases occurred on the right side.

Taken together, the pattern of more marked shoulder muscle development among males, sex differences in osteoarthritic patterning, and the dramatically higher preponderance of pathological rotator cuff changes among males, especially on the right side, supports the idea that males were using spearthrowers fairly intensively. This study illustrates the capability of bioarchaeological research to both confirm and expand on hypotheses drawn from other types of archaeological data.

Factors influencing census results on *Lepilemur* and *Microcebus* in southwestern Madagascar. L. T. NASH  
Anthropology, Arizona State University, Tempe, AZ  
85287-2402.

*Lepilemur leucopus* and *Microcebus murinus* were censused at Beza Mahafaly Special Reserve, in Southwestern Madagascar. The vegetation in Parcel One of the Reserve varies from the more mesic east end to the more xeric west end. Repeated line transect surveys were conducted in both parts of reserve. Surveys were matched for season (wet vs. dry) and for moon phase. Measures of population size were estimated by (1) abundance, i.e., number of animals encountered per kilometer walked, and, (2) density estimates based on the length of the transect walks and detection width estimates made at intervals along survey paths. *Lemur catta* are more abundant in the wetter end of the reserve [Sussman, 1991]. This may be due to the importance of fruit in the ring-tailed lemur's diet and the effect of moisture on fruiting patterns. *Lepilemur* at this site eat leaves [Nash, 1998] and the diet of *Microcebus* is probably fruit and insects. Neither species showed an effect of moon phase or season on census results. While no effect of the vegetation gradient was found on *Lepilemur* abundance and density, mouse lemurs were more abundant and dense in the more xeric end of the reserve (opposite to *Lemur catta*). Also, while *Lepilemur* was more dense inside the reserve than outside in more disturbed habitat, the reverse was so for mouse lemurs. This supports other reports of differences between these species in tolerance of forest disturbance.

Supported by the Wenner-Gren Foundation for Anthropological Research and the National Geographic Society.

Diet of the Slender Lorises (*Loris tardigradus lydekkerianus*) in Dindigul District, Tamil Nadu, India. K.A. NEKARIS.  
Department of Anthropology, Washington University, St. Louis, MO 63130.

During an 11 month study of the socioecology of the slender lorises (*Loris tardigradus lydekkerianus*) in a dry scrub jungle of Tamil Nadu, India, information on diet was systematically recorded. In more than 1200 hours of observation, over 2000 feeding incidents were noted. Male and female adults, juveniles and infants were observed throughout the night or for as long as possible. Lorises were observed with the aid of red light, and were easily followed by one to four people at a distance of 2-5m. The following variables were recorded: item eaten, method of capture, position and location while feeding, and amount eaten per feeding session. With the exception of two geckos (*Hemidactylus* sp.), two seed pods (*Prosopis*), and gum (*Alacia, Prosopis*), lorises ate almost exclusively invertebrates, including molluscs (slugs and snails) and arthropods (mainly insects). Orders of insects eaten include: Orthoptera, Hymenoptera, Coleoptera, Lepidoptera, Isoptera, and Odonata. Lorises almost always grabbed prey with one hand, though flying prey was caught with two hands. Gum and sometimes ants were collected with the mouth. Sleeping, cryptic and colonial insects, along with snails and slugs, were picked

off branches. Insects from the undergrowth, active insects and lizards were caught by stealth. Furious urine washing preceded the consumption of some beetles, moths and ants. No one sense seemed most important in locating insects; vision, scent and hearing all seemed to play a role in prey capture. Furthermore, insects were caught from all areas of a tree; no preference was shown for insects near the trunk, on terminal branches, in the crown, or in the undergrowth. Feeding rate varied; lorises were observed to eat from zero to sixty insects in one hour and up to two hundred insects in one night. The results of this study suggest that *L. t. lydekkerianus* ranks along with tarsiers as the most faunivorous primates. In contrast to previous studies of other lorises, it does not appear that *L. t. lydekkerianus* specializes in cryptic and repugnant prey, but utilizes a broad spectrum of toxic and high quality insects.

This project was supported by grants from One with Nature of the Philadelphia Zoo, Sophie Danforth Conservation Biology Fund, Primate Conservation Inc., Wenner-Gren Foundation, and NSF (SBR-9714870).

When Two Worlds Collide:  
Biology and Culture in the Glacial Kame Archaic  
A. Russell Nelson  
Museum of Anthropology  
University of Michigan

The Late Archaic Glacial Kame has been characterized both as a Culture (Cunningham, 1948; Morgan, 1952) and a Burial Complex, the latter distinguishing it from other regionally identifiable manifestations of mortuary custom occurring around 1500 to 1000 BC in Michigan, Ohio, southern Ontario, parts of Indiana, and Wisconsin (Fiedel, 1992:236; Sciuilli, 1987; Sciuilli and Schneider, 1985; Schneider and Sciuilli, 1983). Investigations of population relations based on metric and discrete trait observations have advanced the hypothesis that the geographical distance between samples is associated with biological affinities between samples, and that this factor had a greater effect than cultural affiliation (Sciuilli and Schneider, 1985:430). This paper examines these relationships in the context of Archaic samples totaling 242 individuals representing Alabama, Tennessee, Kentucky, Ohio, Ontario, and Newfoundland. In addition, a set of smaller samples (29 individuals) from Florida, Michigan, Ohio, Indiana, Alabama, Minnesota, Wyoming and New Mexico is used for individual to comparative sample distance testing. Much of this material was used in continental scale examination of population relations utilizing craniometric data with cluster and discriminant function analytic methods and a database of approximately 5000 individuals representing North and South America, the Pacific Basin, and Asia (Nelson, 1998). The hypothesis stated by Sciuilli and Schneider (1985) is generally supported, although the picture of "border zone" relationships of the Ohio Glacial Kame sites between the Northern and Central Valley Archaic biological cluster groups suggests more complex patterns of settlement and interrelations than a limited analytic model would indicate.

Degenerative disk disease in *Macaca nemestrina*. L. NEWELL-MORRIS, Dept. of Anthropology and Regional Primate Research Center, P.A. KRAMER, L. SANTONI, Dept. of Anthropology, P. SIMKIN and S. OTT, Dept. of Medicine, University of Washington, Seattle, WA 98195.

Osteoarthritis has been reported in a wide range of mammalian species, including the primates. One form, spinal degenerative disk disease (DDD), defined by the presence of narrowing at one or more intervertebral space(s) and at least one anterior osteophyte in an individual, occurs in both macaques and humans. Although its development is commonly attributed to an interaction of senescence in joint tissues and biomechanical influences, the etiological mechanisms are poorly understood. A comparison of the anatomical distribution and temporal progression of DDD in the human and macaque species, which differ in both rate of aging and postural and locomotor behaviors, presents, therefore, a potentially informative approach.

The samples consisted of lateral spinal radiographs from 108 female pig-tail macaques (*Macaca nemestrina*) aged 5.2 to 29.2 yrs from the RPRC breeding colony and 39 normal women aged 60 to 78 yrs participant in a survey of osteoporosis. Using a version of the atlas method of Lane *et al.* (1992), two observers (PK and LS) scored intervertebral spaces for narrowing and vertebrae for osteophytosis. All lumbar and thoracic vertebrae 12 to 8 were scored.

Among macaques, DDD was not seen in animals <12 yrs (n= 78) and was ubiquitous after 17 yrs (n= 10). Disk narrowing was present at younger ages than was osteophytosis (earliest cases 5.5 yrs vs 9.3 yrs, respectively). While first evidence of narrowing was randomly distributed throughout the spine, initial osteophytosis was concentrated in the thoracic vertebrae. Among those animals with osteophytosis, 83% exhibited osteophytes at the T9/10 and T12/L1 spaces. Among women, 69% showed narrowing, compared with 100% of macaques in an equivalent age range (>15 yrs). In contrast, the prevalence of osteophytosis was 95% and 100% in macaques and humans, respectively.

We conclude that disk narrowing and osteophytosis may develop and interact differently in the two species. The macaque, therefore, presents an excellent model with which to explore the interaction of biological aging and biomechanics. Supported by the UW Royalty Research Fund, NSF SBR-9319278 and NIH ROI AR40813 and R00166.

Mitochondrial DNA sequence variation in baboons (*Papio hamadryas*). T.K. NEWMAN, C.J. JOLLY\* and J. ROGERS, Southwest Foundation for Biomedical Research, San Antonio, TX 78245, \*Dept. of Anthropology, New York University, NY, NY. 10003.

*Papio hamadryas* is distributed across sub-Saharan Africa, and consists of 5 or more subspecies, or "morphotypes". Diverse in form and behavior, baboons are an ideal species for addressing questions of evolutionary biology, yet little is known about the phylogeographic structure of these populations. We sequenced ~830 bases of the mitochondrial genome, spanning portions of the ND 4&5 genes and three tRNAs. Our

sample set includes 33 haplotypes (43 individuals) representing hamadryas, olive, yellow, guinea and chacma subspecies, and 3 outgroups (*T. gelada*, *M. mulatta* and *C. aethiops*). Each taxon is represented by a minimum of 5 individuals.

Sequence diversity in this sample is high; pairwise comparisons within *Papio* reach differences greater than 5%, but within subspecies is generally much lower (<2%), except in hamadryas (~3.2%). Cladistic analyses (parsimony and distance methods) were performed to reconstruct the history of matrilineal differentiation. Chacma and guinea haplotypes each form robustly supported monophyletic clades. Olive and yellow haplotypes form a single clade with little diversity or internal resolution, but show marked differences from guineas and chacmas. Hamadryas haplotypes fall into several clades and are thus paraphyletic. At present, the variability and distribution of mtDNA lineages suggests that: 1) olive and yellow baboons cannot be resolved into distinct clades, 2) guinea and chacma haplotypes are clearly distinct from those of other subspecies, and 3) hamadryas may be the outgroup to all other baboons, but paraphyly in the mtDNA phylogeny indicates that introgression between hamadryas and other subspecies may be a recurrent event in their evolutionary history. More analyses of these individuals and sampling of additional populations is required before a detailed description of baboon matrilineal population structure and history is possible.

The Pleistocene component of the native American population: A linguistic perspective. J. NICHOLS, Slavic Languages, UC Berkeley, CA 94720.

A Pacific Rim linguistic population extending the length of the Pacific coast in the Americas is distinguished by unevenly distributed high frequencies of certain diagnostic linguistic markers and contains enough discrete families of the maximally traceable age that it must have formed through two or more separate immigrations of coastally adapted people beginning 12,000 - 15,000 BP. The non-Pacific Rim linguistic population of the Americas is much older and therefore of Pleistocene antiquity. Its age, internal structure, and external affinities are possible indicators of the chronology, frequency, and sources of the American colonizations.

The following conclusions can be drawn about the older linguistic population (all are based on frequency and distribution of relatively durable grammatical markers). (a) All markers are well distributed throughout the older population, indicating great age and much intermingling of different language families. (b) The closest grammatical affinities of American languages are with other American languages, and Australasia and Southeast Asia are in a distant second place; this indicates founder effects and/or long interaction in an immigrant population derived ultimately from east Asia. (c) There is some evidence of a north-south gradient with eastern/interior North America showing affinities to coastal Australasia and eastern/interior South America closest to interior Australasia, suggesting a series of immigrations with the source population changing over time (and feeding both the American and the Australasian colonizations). (d) Founder effects in the linguistic population of eastern and central North America indicate a postglacial northward



spread from the vicinity of Mexico or Central America; there is no evidence at all that interior North American languages are recently derived from Siberia.

The general picture that emerges is occasional colonizations over a long period, beginning before the glacial maximum; a colonizing population ultimately derived from coastal east Asia; founder effects in the overall population; long interaction after immigration; postglacial (re)colonization of North America from the south; at best only slight correlations of marker frequencies with distance and direction from entry point. The Pleistocene linguistic population was shaped more by post-immigration interactions than by immigration history.

Expected genetic correlations are evidence of the postglacial coastal immigration with its southward spread, and great age, well-mixed diversity, and ultimate Asian origins for the non-Pacific population.

Comparisons in linear skeletal dimensions of captive versus wild lowland gorillas. K.A. NICHOLS, University of Colorado, Boulder, CO, 80309

This study addresses quantitative information on patterns of linear skeletal dimensions in captive versus wild lowland gorillas. The results establish the degree of variation in skeletal dimensions in the two groups. In addition, the data provide a comparative base for studies of soft-tissue anatomy.

The sample consists of 80 adult wild (59 male, 21 female) and 15 adult captive (9 male, 6 female) lowland gorilla individuals. 49 osteometric variables consisting of cranial, dental, and post-cranial measurements are reported in descriptive statistics (mean averages, standard deviation) and are submitted to significance tests including student's *t*-test.

In most measurements, captive lowland gorillas are slightly larger than are their wild counterparts but those patterns vary by sex. For example, average femoral length does not differ greatly between the two populations (captive:  $n = 12$ , mean = 369.36 mm,  $s = 32.0$ ; wild:  $n = 20$ , mean = 356.27 mm,  $s = 34.71$ ). Females, however, show a greater degree of variation than do males (female, captive:  $n = 4$ , mean = 332.67 mm,  $s = 9.58$ ; female, wild:  $n = 6$ , mean = 310.33 mm,  $s = 12.19$ ; male, captive:  $n = 8$ , mean = 387.71 mm,  $s = 20.53$ ; male, wild:  $n = 14$ , mean = 375.95 mm,  $s = 17.67$ ). The highest degree of difference in captive and wild samples is measured in the variables of the anterior craniodental region. For example, the maxillary diastema is distinctly larger in captive individuals (captive:  $n = 7$ , mean = 16.8 mm,  $s = 4.70$ ; wild:  $n = 67$ , mean = 7.28 mm,  $s = 2.58$ ) across both male and female samples (male, captive:  $n = 5$ , mean = 17.0 cm,  $s = 5.96$ ; male, wild:  $n = 48$ , mean = 7.78 mm,  $s = 2.60$ ; female, captive:  $n = 2$ , mean = 14.15 mm,  $s = 0.95$ ; female, wild:  $n = 19$ , mean = 6.03 mm,  $s = 2.11$ ).

These data provide one dimension for assessing the patterns of variation in captive versus wild lowland gorillas. The results complement soft tissue and body weight research and locomotor and dietary behavioral studies.

Calcaneal erosions as a marker of inflammatory arthritis during the Late Woodland period. S.E. NIEBUHR, Department of Anthropology, Indiana University, Bloomington, IN 47405; and E.M. BRAUNSTEIN, Department of Radiology, Indiana University, Indianapolis, IN 46202

Erosions of the calcaneus at the insertion of the Achilles tendon are an important indicator of rheumatoid arthritis and reactive inflammatory arthritis such as that seen in Reiter disease, psoriatic arthritis, and ankylosing spondylitis. In these conditions, inflammatory synovitis of the retrocalcaneal (sub-Achilles) bursa causes pressure erosion of the adjacent calcaneus.

Such calcaneal erosions were found in three of eight adult individuals in whom calcanei were present, from Albee Mound, Indiana. Additional skeletal findings, notably reactive bone and pathologic erosions of the metatarsals, were also present in these individuals. Radiographs of pathologic findings were obtained and compared with gross bone observations to better ascertain the nature and the extent of the lesions, leading to the differential diagnosis for these individuals. Implications for the presence of rheumatoid arthritis in the Albee phase of the Late Woodland period in Indiana require rethinking of current ideas for the prehistoric distribution of rheumatoid or reactive arthritis in North America.

A photogrammetric analysis of the metacarpal 1 base of Late Pleistocene and recent (Holocene) humans. W. A. NIEWOEHNER, University of New Mexico, Department of Anthropology, Albuquerque, NM 87131.

Neandertal and recent human trapeziometacarpal 1 articulations are distinct from each other, particularly in the degree of dorsopalmar curvature of the metacarpal 1 (MC1) base. Neandertal MC1 bases are dorsopalmarly flatter than that observed in recent human samples. Articular shape is often quantified with chord to subtense ratios. This technique documents gross morphological differences, but fails to provide detailed information on functionally relevant between-sample shape differences. This study uses photogrammetry to quantify articular morphology.

The samples consist of the MC1 of Late Pleistocene (Neandertal:  $N = 8$ ; Qafzeh 9 and Skhul V; Upper Paleolithic associated:  $N = 12$ ) and Holocene ( $N = 36$ ) hominids. The specimens are marked by projecting a 10x10 grid onto the articular surface and photographed from three to four angles. The grid intersections are digitized and processed with photogrammetry software (EOS Systems Photomodeler Pro) to produce an array of scaled 3-D coordinates (see Niewoehner, 1998).

Shape differences are apparent in the palmar aspect of the MC1 base. The palmar third of the Holocene hominid MC1 base curves proximally to produce a prominent beak (Barmakian, 1992). The Upper Paleolithic sample resembles Holocene humans in this respect. Neandertals gener-

ally lack a prominent beak. Qafzeh 9 and Skhul V have a poorly developed palmar beak.

A well-developed palmar beak may assist in effectively transmitting shear forces to the trapeziometacarpal ligaments and the joint capsule, stabilizing this articulation when external forces are applied to the palmar aspect of the MC1 shaft. Though inherently less stable, the Neandertal trapeziometacarpal articulation could have been further stabilized by hypertrophied fibrous and ligamentous attachments and hypertrophied pollical muscles.

This research is supported by the L.S.B. Leakey Foundation and the N.S.F.

Feeding rates and social dominance among white-faced saki females. M.A. NORCONK<sup>1</sup>, T.M. GLEASON<sup>2</sup>, and A. L. HARRISON<sup>1</sup>, Anthropology, Kent State University, Kent OH 44242<sup>1</sup> and Anthropology, Washington University, St. Louis MO 63130<sup>2</sup>.

Regardless of mating strategy, many platyrrhines live in small family-sized groups that appear to be rather egalitarian socially, i.e. aggressive interactions are rare, and dominance ranks are difficult to discern. Nevertheless, feeding competition might be predicted for a number of these species since many are predominantly frugivorous, relying on resources that may be rare temporally and/or spatially. This report is part of a long-term study of white-faced sakis (*Pithecia pithecia*) living in Lago Guri, Venezuela. We investigated feeding activities of 3 adult females representing 3 generations of sakis living in the same social group. The youngest was a young adult (4.5 yrs) at the time of the study in the summer, 1997. We were interested specifically in feeding competition and collected both social data (feeding party size, nearest-neighbor distance, rate of food intake, and feeding duration/feeding bout) and ecological data (species, dbh, canopy breadth, fruit abundance, and mechanical protection of fruit). Agonistic behavior was rare, occurring in only 4.7% of samples (N = 265). Feeding rates for all 3 females were highest in small-crowned trees, where foraging group size was small and feeding duration was short. The variable "fruit protection" had a very strong effect statistically on feeding rates. While there were no statistically significant differences in the feeding rates of the 3 females, the oldest female maintained the highest feeding rates in *Licania discolor* (Chrysobalanaceae) trees. *L. discolor* produce protected seeds with high lipid values. In these large-crowned trees, she fed in larger groups with shorter nearest-neighbor distance than the other two females, which may have conferred a benefit in lowering predation risk. For some platyrrhines, benefits and costs associated with differences in social status might be seen more clearly in the context of feeding than in rare aggressive interactions. Supported by a Wenner-Gren Foundation grant.

Fertility in post-menopausal American Indian women: The Strong Heart Study. KE NORTH, JW MACCLUER, Department of Genetics, Southwest Foundation for Biomedical Research, San Antonio, TX, LD COWAN, Department of Biostatistics and Epidemiology, University of Oklahoma, Oklahoma City, OK, and BV HOWARD, Medlantic Research Institute, Washington, DC.

The Strong Heart Study (SHS) is a study of cardiovascular disease (CVD) morbidity and mortality and risk factor prevalence in American Indians living in Arizona, Oklahoma, and the Dakotas. The purpose of the present study was to examine the fertility of a large sample of American Indian women participating in the Strong Heart Study and to determine which factors are associated with variation in completed fertility among these populations.

Data were derived from a baseline examination in 1989-1992, when 1500 men and women, age 45-74, from each of the three SHS centers were examined. A personal interview elicited demographic information, family health history, and information on several lifestyle variables. A total of 1955 ever-married, post-menopausal women were considered in these analyses. Women were considered to be post-menopausal if their menstrual cycles had stopped completely for at least twelve months.

The average number of pregnancies (gravidity) for all women was 5.9 whereas the mean number of live births (parity) was 5.3. Women living on reservations (Arizona (5.6) and the Dakotas (5.8)) had higher completed fertility than their more urban counterparts (Oklahoma (4.6)). Furthermore, there was lower fertility in younger women. For example, when American Indian women from all three centers were considered together, women born between 1910 and 1919 had a mean parity of 5.34 whereas women born between 1940 and 1949 had a mean parity of 4.0. Although previous research has suggested a relationship between parity and CVD risk factors, no linear associations between CVD risk factors and fertility were identified here. We also examined the relationship of contraception, level of education, and income to fertility. While no significant relationship between contraception and the level of fertility was identified, there was a significant inverse linear relationship of both education and income with fertility. In summary, fertility rates in American Indian women are high, but appear to be decreasing in younger generations. Fertility is higher in those with less education and lower incomes.

#### **Coping with exclusion and inclusion: Ribeirinhos of the Amazon estuary. S. Nugent**

Department of Anthropology, Goldsmiths University of London and Institute of Latin American Studies, UK.

Three decades of economic modernization in Amazônia have resulted in major changes to

natural and social landscapes. For historical peasantries of Amazônia (glossed here as *caboclos*) the impact of modernization strategies has registered in an uneven manner over the region.

This paper looks at a small island community of the Amazon/Guamá estuary and examines changes in the way petty commodity producers accommodate the stressed demands of local social organization and pressures of the market.

The number of males in primate social groups: a comparative test of the socioecological model. C.L. NUNN, Department of Biological Anthropology and Anatomy, Duke University, Durham, NC 27708.

As it applies to polygynous primates, the current socioecological model assumes that environmental risks and resources determine the spatial and temporal distribution of females, and this female distribution then sets male strategies for monopolizing fertile matings. At present, however, the relative importance of spatial effects (i.e. female number) and temporal effects (female estrous overlap) remains unclear and controversial in cross-species patterns of male representation in primate social groups.

In this talk, I use multivariate statistical techniques to assess the relative roles of spatial and temporal effects in the context of a phylogenetically corrected dataset. I use three independent measures of female overlap in these tests. First, I show that both female number and breeding seasonality predict male number. Second, I show that expected estrous overlap, after partialling out the effect of female group size using residuals, also significantly accounts for the number of males. Finally, I show that actual estimates of estrous overlap significantly predict male number, again after correcting for female group size. These results are relatively insensitive to phylogenetic uncertainty (a total of four phylogenies, with two sets of branch length estimates for each tree). This significant effect of temporal overlap in the socioecological model is contrary to a previous comparative test (Mitani et al. 1996. *American Journal of Primatology* 38: 315-332); however, these tests confirm that female group size does explain more of the variance than female temporal overlap. I conclude that a complete socioecological model for primates should include both spatial and temporal factors.

A Standardized Methodology for Scoring Vertebral Osteophytosis. K.C. NYSTROM, M.A. SCHILLACI, E.A. CARSON, M.L. RHOADS AND E.G. OZOLINS, Department of Anthropology, University of New Mexico, Albuquerque, New Mexico 87131.

There has been a considerable amount of research examining the distribution and degree of vertebral osteophytosis within skeletal samples. These studies have primarily focused on elucidating the etiology of osteophytosis, by examining the effects of bipedalism, age, sex, race, and occupation along with numerous other demographic factors. Though diverse in their concentration, one aspect remains consistent throughout, there is no universal standardized methodology for scoring the degree and distribution of vertebral osteophytes.

Traditionally, the scoring of osteophytes is based on the individual researcher's own subjective criteria, leading to potential discrepancies between researchers and an overall incompatibility of the data. This personalized, subjective method of scoring does not permit inter-populational comparisons of osteophytic development. Comparisons of vertebral osteophytosis between groups are therefore restricted to only generalities concerning severity and distribution of osteophytosis within the spinal column.

In an attempt to facilitate these inter-populational comparisons, a standardized, metric based methodology is described for scoring vertebral osteoarthritis and osteophytosis. This method was developed and tested for interobserver error on a subsample of the donated skeletal collection from the Maxwell Museum Laboratory of Human Osteology at the University of New Mexico. The method is implemented on an independently derived random subsample of 53 skeletons from the same skeletal population.

The utilization of this methodology will allow direct comparisons of populations. Researchers will be able to compare osteophytic severity, percentage of the population affected, prevalence within the column, and the most susceptible demographic portion of the population.

New findings on the distinctive gorillas of the Nigeria-Cameroon border region. J.F. OATES and K.L. McFARLAND, Anthropology, City University of New York, New York, NY 10036; R.M. STUMPF and J.G. FLEAGLE, Anatomical Sciences, SUNY at Stony Brook, NY 11794; and T.R. DISOTELL, Anthropology, New York University, New York, NY 10003.

The gorillas inhabiting the forested mountains in the region of the Nigeria-Cameroon border are separated by about 400 km from the nearest population in southern Cameroon. They occur further north and west than any other living gorillas, and over an altitudinal range from 200 m (in Cameroon) to 1600 m (in Nigeria).

The gorilla population in this region is divided into at least four subpopulations. A tentative estimate of total population

size is 200-250, with the smallest subpopulation possibly containing <20 individuals. Surveys to obtain more precise numbers are underway.

The behavioral ecology of one of the subpopulations, in Nigeria's Afi Mountains, has been studied by gathering evidence from nest sites, feces, and feeding trails. Nest group size has been found to be highly variable, with a maximum of 38 nests occurring at one site. Afi has a long and intense dry season, and gorilla diet varies across seasons; many herbs and vines are eaten in the dry season and more fruit in the rains.

A reanalysis of cranial measurements first published by Groves (1970) has found that, based on indices of morphological shape, the Nigerian gorillas are the most distinctive population of western gorillas. They are as distinct from other western gorillas as eastern mountain gorillas are from eastern lowland gorillas. Mitochondrial DNA is therefore being sequenced to investigate the extent to which these gorillas are genetically distinct from other western populations.

Wildlife in the Nigeria-Cameroon border region is subject to intense hunting by humans. Although hunting pressure on the gorillas has eased recently, the small size and the fragmentation of their population leaves them at high risk of extinction. This, together with their distinctiveness, makes these gorillas a very high priority for conservation action. There is an urgent need for more rigorous protection of all the remaining subpopulations.

Facial growth and sexual dimorphism in some Papionin species. P O'HIGGINS and M COLLARD, University College London. WC1E 6JJ.

Sexual dimorphism in the primate facial skeleton is considered to arise mainly through relative extension (hypermorphosis; time or rate) in the male of a growth trajectory (here defined as ontogenetic changes in shape and size) common to both sexes. Under such a model it is predicted that male and female growth trajectories are very similar though extended in males. Furthermore, the model implies that the pattern of sexual dimorphism observed amongst adults would allow reasonable estimation of ontogenetic trajectories and so of juvenile craniofacial form. This latter implication would be of potential interest in the study of fossil material. Several studies have concluded that hypermorphosis in males is indeed a principal underpinning of facial dimorphism in diverse primate groups.

This study tests the above model by examining the ontogenetic basis of sexual dimorphism in the faces of large and small faced Papionins; (*Mandrillus*, *Papio*, *Lophocebus* and *Cercocebus*). The trajectories of growth in the faces of each of these species are modeled such that the relationship between size and shape during growth can be readily compared between males and females. The growth

models employed here are based on the principal components of shape variation extracted from registered landmark coordinates.

The results indicate that between eruption of the maxillary deciduous dentition and completion of the first two adult molars, males and females share a common growth trajectory. The final stages of facial growth, are, however, marked by a divergence of trajectories between males in females in all the taxa examined. It is concluded that, whilst (rate or time) hypermorphosis is significant in generating facial sexual dimorphism amongst Papionins, it does not explain all aspects. The consequence is that adult sexual dimorphism does not allow a straightforward prediction of infant or juvenile morphology.

Oral tool use among captive orang utans (*Pongo pygmaeus*). R.C. O'MALLEY and W.C. MCGREW, Anthropology & Zoology, Miami University, Oxford, OH 45056.

Eight captive orang utans (*Pongo pygmaeus*) were studied at the National Zoological Park, Washington, D.C., for evidence of laterality of manual function in a selection of daily activities (i.e., groom, eat, brachiate, climb) and in an extractive foraging task. The apes were given wooden blocks embedded with raisins and bamboo browse as raw material for tool making.

Unexpectedly, in about three-quarters of the raisin-extraction bouts the orang utans used the tool in the lips or teeth rather than in their hands. The three adult males showed an overwhelming (>90%) preference for oral tool use, while the subadult male used oral tools about half the time. The four adult females were more varied; two showed extreme preference for oral tools, but two showed only occasional oral tool use. Most individuals preferred short tools (ca. 4-10 cm in length) held in the lips and (probably) supported by the tongue, but the subadult male usually used his teeth to jam a longer tool (ca 15-20 cm in length) into the raisin holes and then removed it more carefully by hand. The variation in technique may reflect larger-bodied individuals having more difficulty holding a thin tool in their fingers, or the social variable of being co-housed.

This oral tool use in captive orang utans resembles that seen by van Schaik *et al.* (1996) among wild Sumatran orang utans. Observation of labial tool use has intriguing implications for the evolutionary origins of elementary technology; unlike dental tool use, which may leave microwear patterns that can be recognized, indications of tool use by soft tissue organs such as the lips or tongue will not be preserved in the fossil record.

Research funded by a University Summer Scholars Grant from Miami University.

van Schaik, C. P., Fox, E. A., & Sitompul, A. F. (1996) Manufacture and use of tools in wild Sumatran orangutans: Implications for human evolution. *Naturwissenschaften*, 83: 186-88.